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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of **Tim WILSON:**

Serial No. : **09/742,006** Group Art Unit: **2661**

Filed : **December 22, 2000**

For : **Server and method to provide access to a network by a computer configured for a different network**

Docket No. : **O8-882240US1**

The Honorable Commissioner of Patents
and Trademarks,
WASHINGTON, D.C.
UNITED STATES OF AMERICA 20231

Sir:

We submit herewith a certified copy of Canadian Patent Application Serial No. **2,293,765** filed on December 23, 1999, which completes the requirements of the priority claim.

Respectfully submitted,

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/lml

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Date: March 29, 2001

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La présente atteste que les documents ci-joints, dont la liste figure ci-dessous, sont des copies authentiques des documents déposés au Bureau des brevets.

Canadian Patent Office

Certification

This is to certify that the documents attached hereto and identified below are true copies of the documents on file in the Patent Office.

Specification and Drawings, as originally filed, with Application for Patent Serial No: **2,293,765,** on December 23, 1999, by **SOLUTIONINC LTD.,** assignee of Tim Wilson, for "Internet Access Server".

S. Gregoire
Agent certificateur/Certifying Officer

January 12, 2001
Date

Canada

(CIPO 68)
01-12-00

OPIC CIPO

RELEVANT AREAS OF TECHNOLOGY

The invention pertains to: Internet access for mobile customers, access to World Wide Web from a Multi-trade of locations with zero configuration changes to the Customer/Client's Personal Computer and access as if they were at their home/office locations.

EXISTING PROBLEMS IN THE ART

Access to the World Wide Web has been via telephone access modem, which has also tied up the Hotel's telephone lines and PBX resources.

SUMMARY OF INVENTION

According to a embodiment of the invention, a server provides plug in and Go access to the World Wide Web with zero change to the Clients Computer. Nor additional software/hardware is added and no configuration or hardware changes are required to the computer.

Among the advantages of the present invention are : it is easy of use, no changes are required to the fundamental resource the Clients personal compute, the Hotel gains revenue or a selling resource to offer Client's and reduces demand upon the PBX.

The Solution IP Product is an Internet Server built on a Linux based software platform (Red Hat). This server resides in a Data Network between a Hub that faces an Internet Providers point of presences on the WWW and an Internal Data Networking of Switches providing Data communications to Clients in rooms and conference centres.

An embodiment of the invention uses Static IP routing. The server is provided with a number of Static IP's. When a Client connects to the server via the Internal Hotel Networks; the IP on the Clients PC is removed from an all external Internet traffic and replaced by the static assigned by the server.

SolutionIP™ Patent Application

Technical Description

SolutionIP™ is a VBN (Visitor Based Network) communication technology that enables devices communicating with the TCP-IP protocol (the communications protocol of the Internet) to seamlessly gain access to a any foreign TCP-IP network that has been connected to a SolutionIP™ server, without requiring those same end users to make any TCP-IP configuration changes to their existing computer systems. In a traditional TCP-IP environment a user would have to manually re-configure a device such as notebook computer to gain access to a foreign (non-company controlled) TCP-IP network.

It can also be assumed that many different current TCP-IP and operating system solutions could be used to establish a connection to a TCP-IP network such as the Internet. Ie one user might be running TCP-IP on a windows NT platform with DHCP enabled, while another user might be running a Unix machine with static IP, DNS and gateway addresses installed. Both will allow access to the Internet if properly installed and connected to a network that has been setup to grant them access to TCP-IP services such as the Internet.

The problem is that these same users would not currently be able to take their notebooks that have been configured to work on their employers office LAN/WAN and plug it into another "foreign" network and expect it to work. They would have to first manually configure their computer to work on the foreign network – a task most users would not be able to accomplish on their own without the support of a network expert. This is obviously not a practical, cost/time effective and realistic task to expect people to use.

The reason for this traditional method of obtaining TCP-IP services such as Internet access is twofold. 1) A general belief by end users that this is their only option and 2) Current TCP-IP communications protocols in all operating systems i.e. unix, linux, windows, MAC, etc have been designed to operate in a preset environment and not to be mobile – that's what modems and dial-up networking is for. Modems, even the fastest 56Kb/s ones, however, are frustratingly slow compared to the speeds that can be obtained on a Ethernet network connected to the Internet at T1 or faster speeds. They also depend on the user having a valid account with an ISP to gain dial-up access to the net. This is fine if you use the net sporadically and can obtain local (i.e. no long distance connection needed to reach your ISP) service. This however, is not the typical case – business people are continually using the net more and more via email, Intranets and Extranets and more often than not have an Internet service that does not provide for local connections wherever they go. For example a user from Halifax that has a ISP account with ISTAR Internet and who was travelling to Nfld. to do business would have to dial long distance back to Halifax to make a connection because ISTAR does not have a local Presence in Nfld.

What problems does SolutionIP solve?

SolutionIP technology overcomes all the above issues and truly gives mobile users the ability to access TCP-IP services, regardless of their systems current TCP-IP configuration by simply plugging in their NIC (and not a modem) into a data jack in the wall and instantly gain access to high-speed TCP-IP based services without any requirement to have an account with any ISP whatsoever.

It also allows for various authentication methods depending on the environment it is installed in For example: In a hotel you might only want to authenticate based on a user accepting the terms and conditions and posted daily usage charge for the accessing the system.

In a corporate boardroom the system might require the user to supply an access code and ID before gaining access to the system.

The SolutionIP server accomplishes this task by forcing the user to launch their favorite web browser which then provides the user with a web page that prompts the user to enter more information or to click on an accept usage conditions/charges before the user is allowed further access to the TCP-IP network that they are attempting to access. The information that the user provides is then associated in an SQL database hosted on the SolutionIP Server with the users unique MAC address and/or combination of other unique identifiers such as an account/ID number, credit card number, frequent flier number etc. to determine if the user is allowed to access the system. If the user provides the correct and required information to access the system they will be allowed access for the time period (in minutes, hours, days etc..) that the log on screen has informed them of. Once that time period has expired, they will need to re-register/authenticate again.

SolutionIP also has the ability to accurately account for and when necessary bill for usage of the TCP/IP network the user is connecting to. In many public areas such as a hotel room there is a requirement for the SolutionIP server to "know" which room a user is connecting from in order to accurately bill that particular room for usage of the system. This is important because you do want to present the customer with the option of entering their room number manually. If this were the case the customer might enter a false number which would cause the system to bill another guests room which would create havoc from a billing/customer service basis.

To overcome this obstacle SolutionIP is able to intelligently detect which "port" on a data network user is connecting from by associating the MAC address of the user with a port on a network device such a switch port on an Ethernet switch, cable/xDSL modem or other network connectivity device. The port number will be associated with a room or other unique billing number in the SolutionIP database which will ensure the that if a user connects through that port the proper room/account number is billed. The SolutionIP server accomplishes this task by examining and reading the SNMP (Simple Network Management Protocol) MIB in the network device's registry table and sends this information to the SolutionIP server database which in turns sends this information to the billing device, such as the PMS (property Management System) in the hotel. We refer to this application as "Port based billing and authentication"

Technology Involved.

Specifically SolutionIP™ is a highly modified version of the Linux OS operating system and custom built drivers on a PC based computer platform with two network cards, a hard drive, a fast CPU and adequate RAM. The server is presently configure to operate in an Ethernet/Fast Ethernet environment, however, the server technology itself is network transport layer independent (it could operate just as easily in an ATM, Token Ring, Dial-Up or other). The currently deployed SolutionIP™ servers need to be located at each physical location where the service is to be deployed. SolutionInc is currently developing a "Carrier Class" SolutionIP server that will sit in a large service provider, such an ISP or Cable Operator's Head End NOC (Network Operations Center) and be able to service many different properties from a central point. A clear example of this solution in practice would be a cable provider that offers high-speed Internet using DOCSIS compliant cable modems could simply install a cable modem in each hotel room of a building and run them back to their cable headend equipment. If our SolutionIP servers were installed at the cable headend, any user attempting to connect to the system would be given the same translation, registration and billing options as our on-site SolutionIP server option. This is an important feaure as it will allow large service providers to roll this service out to many buildings without having to install expensive on-site networking equipment and data wiring at each site.

Supp rting Information

SolutionIP end-user cli nt required minimal configuration

SolutionIP™ has been designed to provide "Plug N' Go" Internet access, whereby users will not have to reconfigure network settings to connect. However, certain system configurations will require users to make minor changes to their network settings. Specific configurations that will require changes include the following:

1. Applications which are proxied will not work until the proxies are disabled. (See HOW TO section for disabling Netscape and Internet Explorer proxies.)

2. Browsers and email applications which automatically initiate a modem dialup connection on startup must disable this feature. (See the HOW TO section to disable this feature in Internet Explorer or Netscape and Outlook).

- Systems configured with a static IP are supported, however gateway and DNS addresses must be specified. Active mode FTP will not be available to these users.

Frequently Asked Questions

1. **What does *SolutionIP™* do?**

- ***SolutionIP™*** *provides Plug N' Go Internet access for both static IP and DHCP IP enabled devices. Most clients will be able to seamlessly connect to a* ***SolutionIP™*** *enabled network without reconfiguring IP settings. All charges will be billed directly to your room's folio.*

2. **What operating systems does *SolutionIP™* support?**

- ***SolutionIP™*** is able to support any operating system with a TCP/IP communications protocol stack which includes:
  - ⇒ Windows 3.1, 95, 98 and NT
  - ⇒ Mac OS 7.5.1 and 8
  - ⇒ Unix, Solaris, LINUX
  - ⇒ Other OS systems being tested
- The services provided by the ***SolutionIP™*** network are compatible with and transparent to most TCP/IP networking systems. (See Limitations section).

3. **What is required to use *SolutionIP™***
   - An Ethernet Network Interface Card and connector.
   - A web browser.
   - A TCP/IP stack.
   - In addition, the TCP/IP stack should be configured either for a dynamic network configuration or for a static network configuration. If a static network configuration is being used, an IP address and subnet mask must be specified, as well as at least one DNS server and a gateway. The gateway must be on the same subnet as your computer's IP address.

4. **What are the benefits of using *SolutionIP™***

   - High-speed access to the Internet without having to change your network settings.
   - Does not tie up your room's phone line.
   - Access to hotel services and local information via VirtualCONCIERGE web site.
   - Increased productivity due to fast connection – no long delays waiting for large email attachments to download via modem.
   - Reduced costs – no long distance charges necessary to connect to modem server.

5. **Do I need to install any special software on my computer to use *SolutionIP™*?**

   - As long as you have the minimum requirements specified, you do not need to install any additional software to use *SolutionIP™*.

6. **Is *SolutionIP™* a secure Internet and network access product?**

   - *SolutionIP™* architecture utilizes switched Ethernet networks to protect guest's network traffic from other guests. In addition, guests are free to use any of a variety of secure IP-based communication protocols and products to protect their data on the Internet.

7. **Why doesn't my FTP client work?**

   - Ensure that you are registered. (See HOW TO section.)

   - If you are using a static IP configuration, you must use passive mode FTP. Consult your applications help section to determine if passive mode FTP is supported. If your FTP client does not support passive mode, you can try using your web browser to access the FTP site (most web browsers use passive mode FTP) or change your network settings to use a dynamic network configuration. (See HOW TO section.)

8. **When I try to access my email / web browser, it always tries to use a modem connection. How can I get rid of it?**

   - The instructions for disabling Internet Explorer automatic modem connections are described in the HOW TO section.

9. **When I try to access a site with my web browser, nothing seems to happen.**

   - Your web browser may be configured to use proxies. To disable proxies, follow the steps in the HOW TO section.

10. **Why can't I access my company's internal email server / web server / ... ?**

    - Since *SolutionIP™* simply provides guests with access to the Internet, any attempts to access your company's computing resources would be routed through the Internet. Your company may have placed security barriers in place to prevent unauthorized access from the Internet. If this is the case, your attempts to access the company systems may be blocked by such security measures. Try accessing a public web site, such as http://www.yahoo.com. If you are able to access the public site, your Internet connection from the hotel is working properly, and the connection difficulties must be related to your company's security measures or Internet connection. Consult your company's Information Services department for assistance.

11. **When I try to access my email using Netscape mail, nothing seems to happen.**

    - Netscape may be configured to use proxies. Follow the steps described in the HOW TO section to disable the proxy.

12. **Why can't I access my Novell server / IPX network / AppleTalk network / etc.?**

    - *SolutionIP™* only deals with network traffic based on the Internet Protocol (IP). Other types of network protocols are not currently supported.

13. **I have an application which uses Microsoft's DCOM, but it doesn't seem to work in the hotel. What is wrong?**

    - DCOM, as well as some other types of protocols, embed information about your network address in the data they send. If your computer is using a static network configuration, SolutionIP™ will translate the network headers of the data you send out over the Internet so that it appears to be coming from a network address associated with the hotel. When the DCOM application at the other end receives your data, the return addresses in the DCOM data and network header will not match. The DCOM application will then be unable to properly process the request. In order to use your DCOM application, you must change your network settings to use a dynamic network configuration (see HOW TO section).

14. **My Virtual Private Network / Kerberos / IPSec / Mobile IP / ... software won't work.**

- Similar to DCOM (see above), many of these applications embed information about your computer's network address within th data they send. If you are using a static network configuration, ***SolutionIP™*** will translate the return address that appears in the network headers of your data so that it appears as if your data is originating from an address associated with the hotel. This allows responses to be returned to you properly under normal circumstances. These protocols, however, are sensitive to this type of translation, and will not allow it. You must change your computer's network settings to use a dynamic network configuration in order to use these protocols (see HOW TO section).

15. **How do I know if I am using a static or dynamic IP configuration?**

Windows 95 or NT
a) Select the Start menu
b) Select Settings
c) Select Control Panel
d) Double Click on "Network"
e) Under the Configuration tab (95) or the Protocol tab (NT), you should see a list item entitled "TCP/IP Protocol" or "TCP/IP binding for [product name] Ethernet Adapter".
f) Highlight this list item and click on the Properties button.
g) Under the "IP Address" tab, the option entitled "Obtain an IP address automatically" (95) or "Obtain an IP from a DHCP server" (NT) will be selected if you are using a dynamic network configuration. If you are using a static network configuration, the option entitled "Specify and IP address:" will be selected and the two text boxes in that section should be filled in.

16. **How do I know if I have a TCP/IP stack installed?**

Windows 95 or NT
a) Select the Start menu
b) Select Settings
c) Select Control Panel
d) Double Click on "Network"
e) Under the Configuration tab (95) or the Protocol tab (NT), you should see a list item entitled "TCP/IP Protocol" or "TCP/IP binding for [product name] Ethernet Adapter".
f) If you see an option of this type, you have a TCP/IP stack installed.

17. **How do I change my computer to use a dynamic network configuration?**

- Complete instructions are given in the HOW TO section of this manual.

18. **What type of technology is *SolutionIP™* built on?**

- The SolutionIP™ is built on a customized Red Hat Linux kernel and unique drivers.

19. **What security features does *SolutionIP™* support?**

- ***SolutionIP™*** offers a flexible authentication scheme that can be customized for different installations. It is capable of logging traffic to detect incoming or outgoing attacks.

20. **How does *SolutionIP™* compare to DHCP?**

- ***SolutionIP™*** supports DHCP as a subset of the complete service offering. Unlike DHCP, the ***SolutionIP™*** server can provide network access whether or not the client computer has been DHCP enabled.

SolutionIP™ Illustrated

Joe Salesman is an account executive with a major publishing company. Joe's company has been very proactive in keeping up with technology, ensuring employees have access to up-to-date computers and network resources including a company-wide Intranet. Joe knows that when visiting customers, both locally and when he's on the road, remote access to Email, documents on his corporate Intranet, and prospective client Web sites is a professional necessity.

Joe has been asked to close a deal with a prospective client who is rumored to be displeased with their current publisher, Joe's main competitor. With little time to prepare, Joe books a flight for the following morning as well as a room at a hotel in the client's city that offers high-speed Internet access. Joe catches the flight but realizes he is

missing a key piece of information which he will need to retrieve from his corporate Intranet as soon as he can get an Internet connection.

Upon arrival at the airport Joe heads to the frequent flier lounge and asks the host if there is an area where he can get an Internet connection. The host informs Joe that their airline has recently installed a system called SolutionPORT™ from SolutionInc Limited that uses SolutionIP™ technology to provide members with immediate high-speed access to the Internet. After plugging his notebook's NIC into one of the data jacks in the lounge and launching his Web browser, Joe is pleased to discover he is connected! No need for a local Internet account. No need to incur long distance charges. No need to suffer the sluggish speed of a dial-up connection. No frustrations with network settings. In seconds, Joe is collecting his Email and downloading the required file from his corporate Intranet!

Joe then proceeds to his hotel. Checking in, Joe is informed of the high-speed Internet access available from each guest's room. Through the hotel's SolutionGUEST™ system, which incorporates SolutionIP™ technology, Joe simply plugs his notebook into the data jack in his room, launches a Web browser, clicks to accept the $15 per diem charge and he's off to the Internet to prepare for his big meeting in the morning!

This scenario demonstrates just a few of the capabilities and applications of SolutionIP™. The internetworking professionals at SolutionInc Limited would like to discuss how they can make this technology work for you!

Here are some more vertical markets where SolutionIP as a standalone product will be deployed in to provide VBN applications t mobile professionals.

Training Centers - This would make it much easier for people to use their own notebooks.
Large Libraries - again many libraries are already gearing up to allow people to use the WWW and find information digitally. This would make it much more cost effective by not having to supply and maintain as many library owned PC's.

Kinko's type places. Instead of having to use the PC's it would be east to put a e-commerce front on SolutionIP so clients can use the Kinko's connection and Printers on their own machines.

Shared office/Hoteling facilities such as IB Your Office - www.ibyouroffice.com This would give them a real edge and reduce their admin MIS costs plus add more billable services to their offerings.

Educational dorms and campus's - this would ease the demands of MIS staff to manually configure 100 or thousands of students as they register for school each year. It would also students to moves back and fourth from off-school networks such a scalable modem service at their apartment or home and unto the school network.

Manufacturing facilities and production lines - their is huge opportunity in this field to use the inherent "follow me" and dynamic registration ability of SolutionIP to in effect "push" software an applications at a users specific to the area/ "IP zone" of the production floor they are say with a wireless connection

Financial Trading hous s - much the same as above -their is a tremendous about of moves add changes regularly taking place here. A person might move to another area of a floor and automatically have that areas applications pushed at him.

Portal/Advertising revenues/license fees from companies that wish to ensure their message is seen at least once.

Branch/Remote Office - where people are regularly coming to and from foreign networks
Government, All levels - self service Kiosks or areas such a business development centers where they provide help and information to people wanting to start their own businesses.

Airport frequent flier lounges and general waiting gate areas you could quickly add data ports near many phones you see in airports with e-commerce interfaces.

Licensing arrangements with ISP's and other Wired and Wireless network providers.

Patent Application

A) Technical Description

SolutionSERVER™ is a communication technology that enables devices communicating with the TCP-IP protocol (the communications protocol of the Internet) to seamlessly gain access to any foreign TCP-IP network that has a SolutionSERVER™ installed, without requiring those same end users to make any TCP-IP configuration changes to their existing computer systems. In a traditional TCP-IP environment a user would have to manually re-configure a device such as notebook computer to gain access to a foreign (non-company controlled) TCP-IP network.

It can also be assumed that many different current TCP-IP and operating system solutions could be used to establish a connection to a TCP-IP network such as the Internet. ie one user might be running TCP-IP on a windows NT platform with DHCP enabled, while another user might be running a Unix machine with static IP, DNS and gateway addresses installed. Both will allow access to the Internet if properly installed and connected to a network that has been setup to grant them access to TCP-IP services such as the Internet.

The problem is that these same users would not currently be able to take their notebooks that have been configured to work on their employers office LAN/WAN and plug it into another "foreign" network and expect it to work. They would have to first manually configure their computer to work on the foreign network – a task most users would not be able to accomplish on their own without the support of a network expert. This is obviously not a practical, cost/time effective and realistic task to expect people to use.

The reason for this traditional method of obtaining TCP-IP services such as Internet access is twofold. 1) A general belief by end users that this is their only option and 2) Current TCP-IP communications protocols in all operating systems i.e. unix, linux, windows, MAC, etc have been designed to operate in a preset environment and not to be mobile – that's what modems and dial-up networking is for. Modems, even the fastest 56Kb/s ones, however, are frustratingly slow compared to the speeds that can be obtained on a Ethernet network connected to the Internet at T1 or faster speeds. They also depend on the user having a valid account with an ISP to gain dial-up access to the net. This is fine if you use the net sporadically and can obtain local (i.e. no long distance connection needed to reach your ISP) service. This however, is not the typical case – business people are continually using the net more and more via email, Intranets and Extranets and more often than not have an Internet service that does not provide for local connections wherever they go. For example a user from Halifax that has a ISP account with ISTAR Internet and who was travelling to Nfld. to do business would have to dial long distance back to Halifax to make a connection because ISTAR does not have a local Presence in Nfld.

SolutionSERVER technology overcomes all the above issues and truly gives mobile users the ability to access TCP-IP services, regardless of their systems current TCP-IP configuration by simply plugging in their NIC (and not a modem) into a data jack in the wall and instantly gain access to high-speed TCP-IP based services without any requirement to have an account with any ISP whatsoever.

B) Technology Involved.

Specifically SolutionSERVER™ is a highly modified version of the Linux OS operating system and custom built drivers on a PC based computer platform with two network cards, a hard drive, a fast CPU and adequate RAM. The server is presently configure to operate in an Ethernet/Fast Ethernet environment, however, the server technology itself is network transport layer independent (it could operate just as easily in an ATM, Token Ring, Dial-Up or other). The

following pages and slides give a more detailed and graphical depiction of SolutionSERVER™ in action.

C) Supporting Information

Some FAQ's

Q. What does SolutionSERVER do?
A. SolutionSERVER is able to provide translation services for computers that support Ethernet. This allows the computer to operate in a "foreign" LAN, regardless of the original IP address or configuration of the computer. SolutionSERVER does not require any special software or end-user configuration.

Q. What client operating systems does SolutionSERVER support?
A. The SolutionSERVER is able to support any operating system with a TCP/IP communications protocol stack. The services provided by the SolutionSERVER are fully compatible with and transparent to TCP/IP networking systems.

Q. What type of technology is SolutionSERVER built upon?
A. The SolutionSERVER is built on a customized Red Hat Linux kernel and unique drivers.

Q. How many users can SolutionSERVER support?
A. A base SolutionSERVER is capable of supporting between 100 and 400 simultaneous users, depending on traffic flow and configuration. Higher numbers are easily achievable with more server horsepower.

Q. What security features does SolutionSERVER support?
A. SolutionSERVER is capable of authenticating based on username and password, IP address or Ethernet MAC address or any other high level of authentication such as a secure ID card.. It is capable of logging all traffic to detect incoming or outgoing attacks, and provides remote notification services for client activity, all through a web based admin section.

Q. How does SolutionSERVER compare to DHCP?
A. SolutionSERVER supports DHCP as a subset of the complete service offering. Unlike DHCP, the SolutionSERVER can provide network access whether or not the client computer has DHCP enabled. SolutionSERVER is also capable of supporting clients whose existing DHCP lease has not yet expired.

User Platform Compatibility

- Windows 3.1, 95, 98 and NT
- Mac OS 7.5.1 and 8
- Unix, Solaris, IRIX, LINUX
- Other platforms in testing

Client Requirements

- Ethernet interface (SolutionSERVER can be easily configured to run on any networking transport layer including dial-up)
- TCP/IP protocol stack

SolutionSERVER Includes:

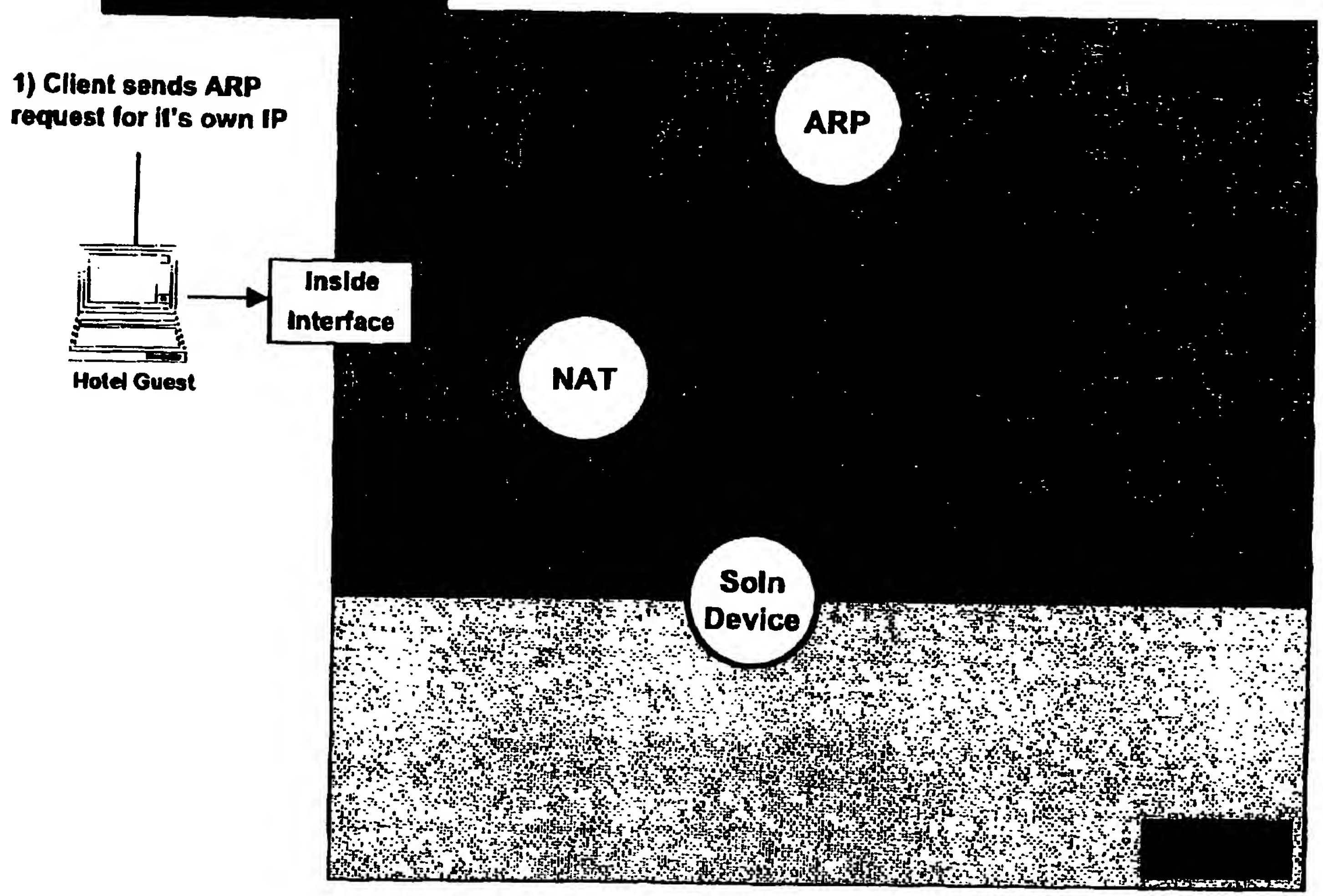
- On-line help Web based help
- Configuration and user manuals
- Remote management via Telnet

Security

- SolutionSERVER supports password and Mac address based security as a standard feature, however many other layers of security can be added to it's functionality.

Data Transmission Protocols

SolutionInc — SolutionSERVER Fixed IP Startup



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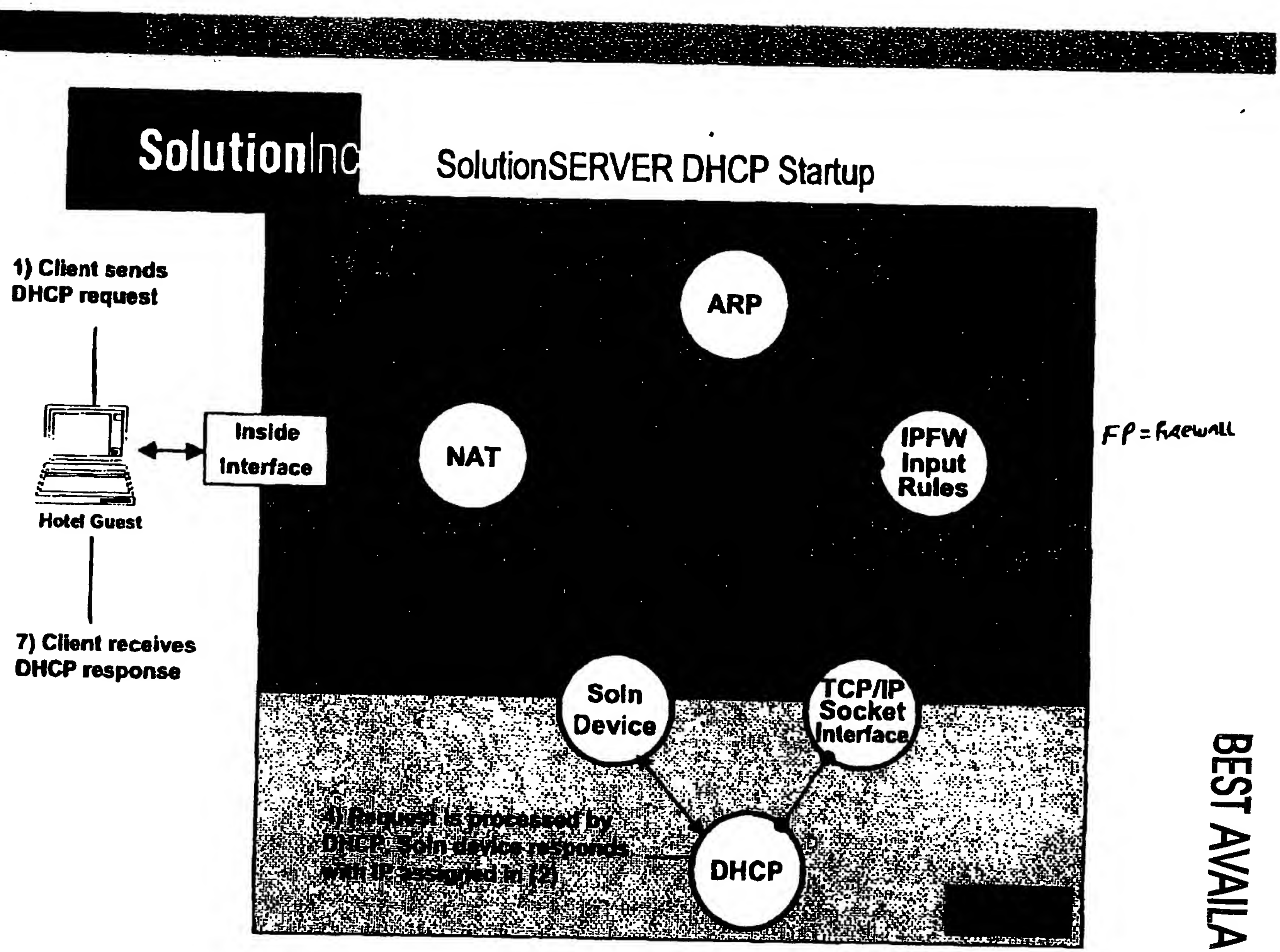
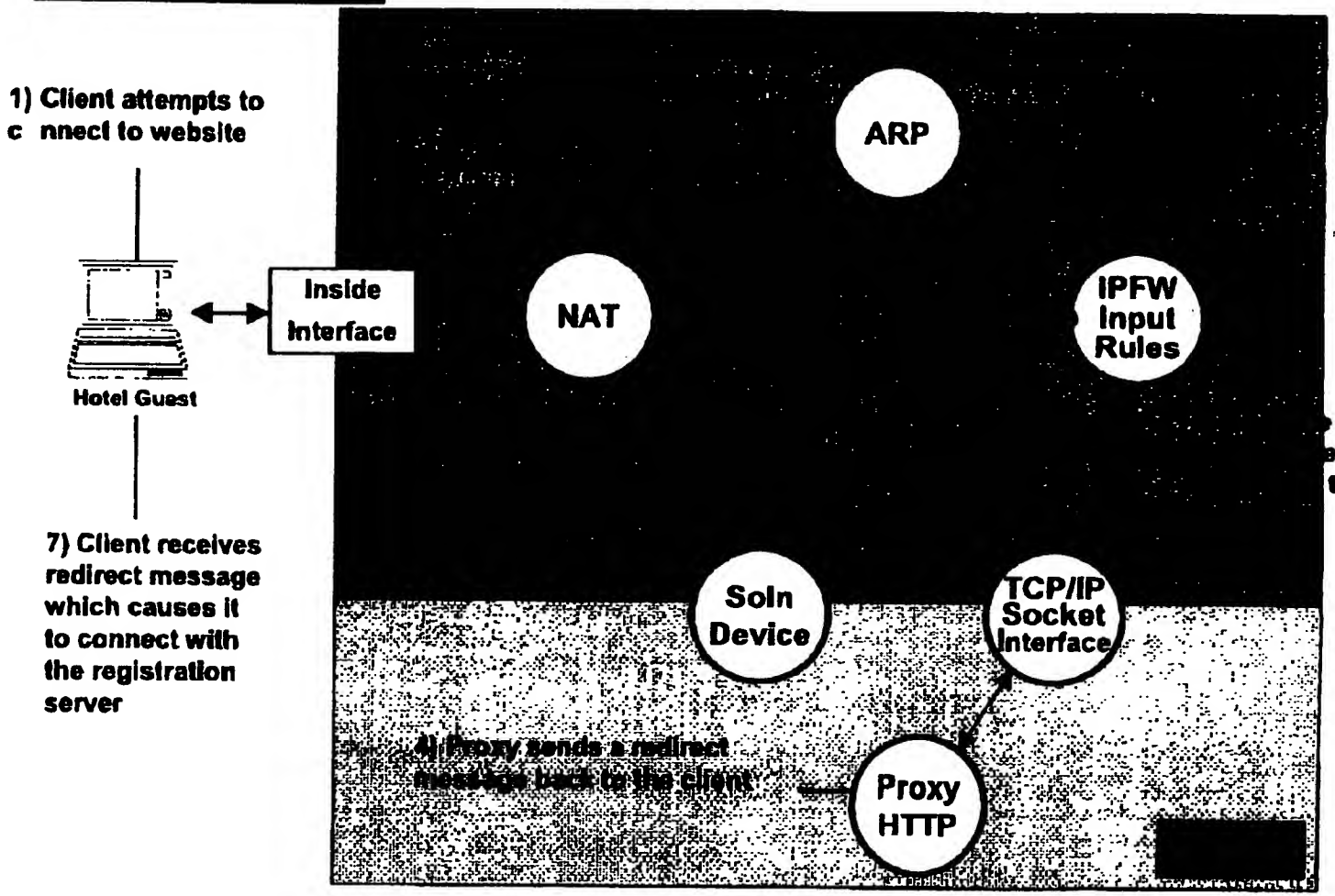


CA 02293765 1999-12-23

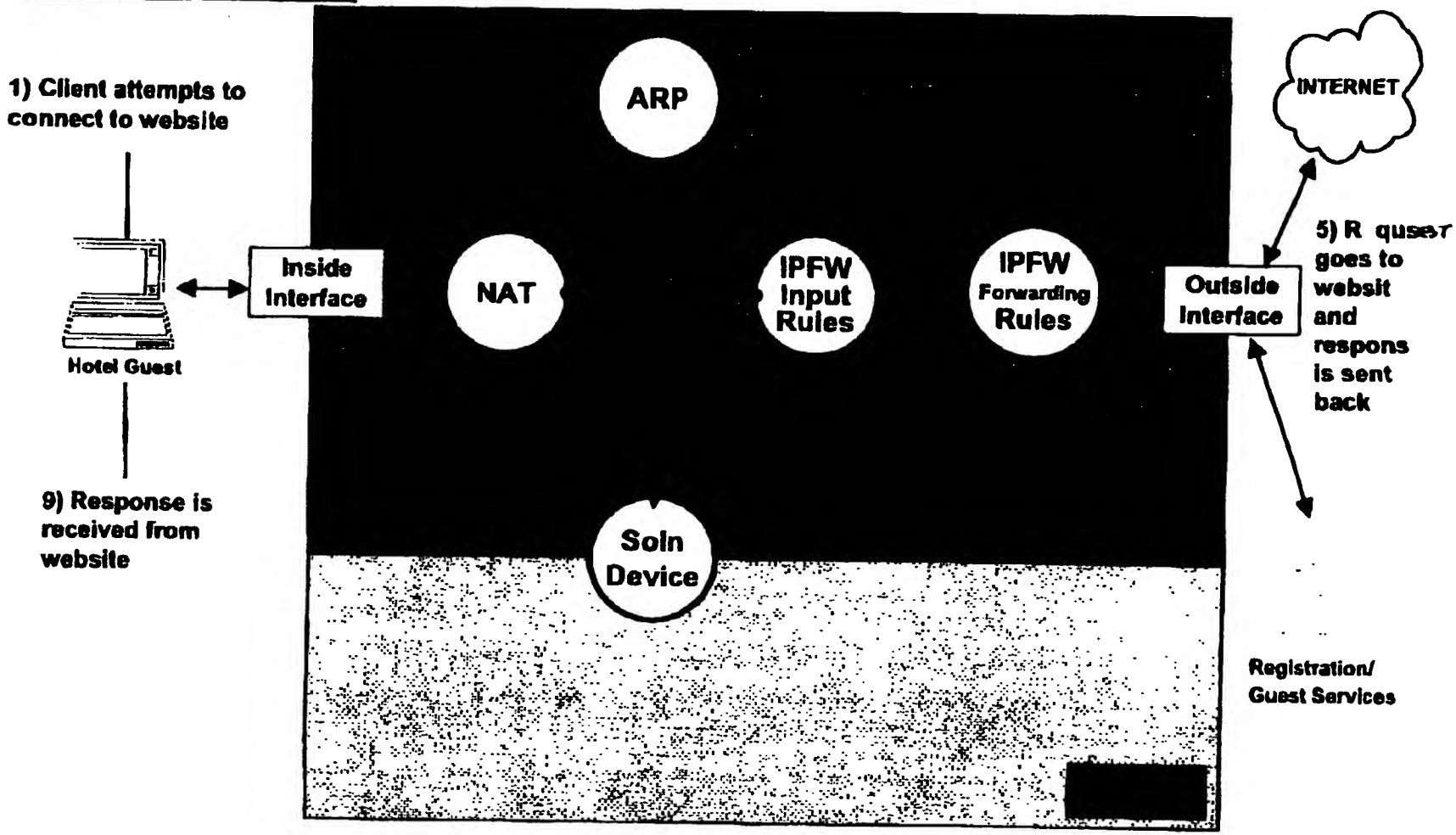
SolutionInc

SolutionSERVER Unregistered HTTP Request



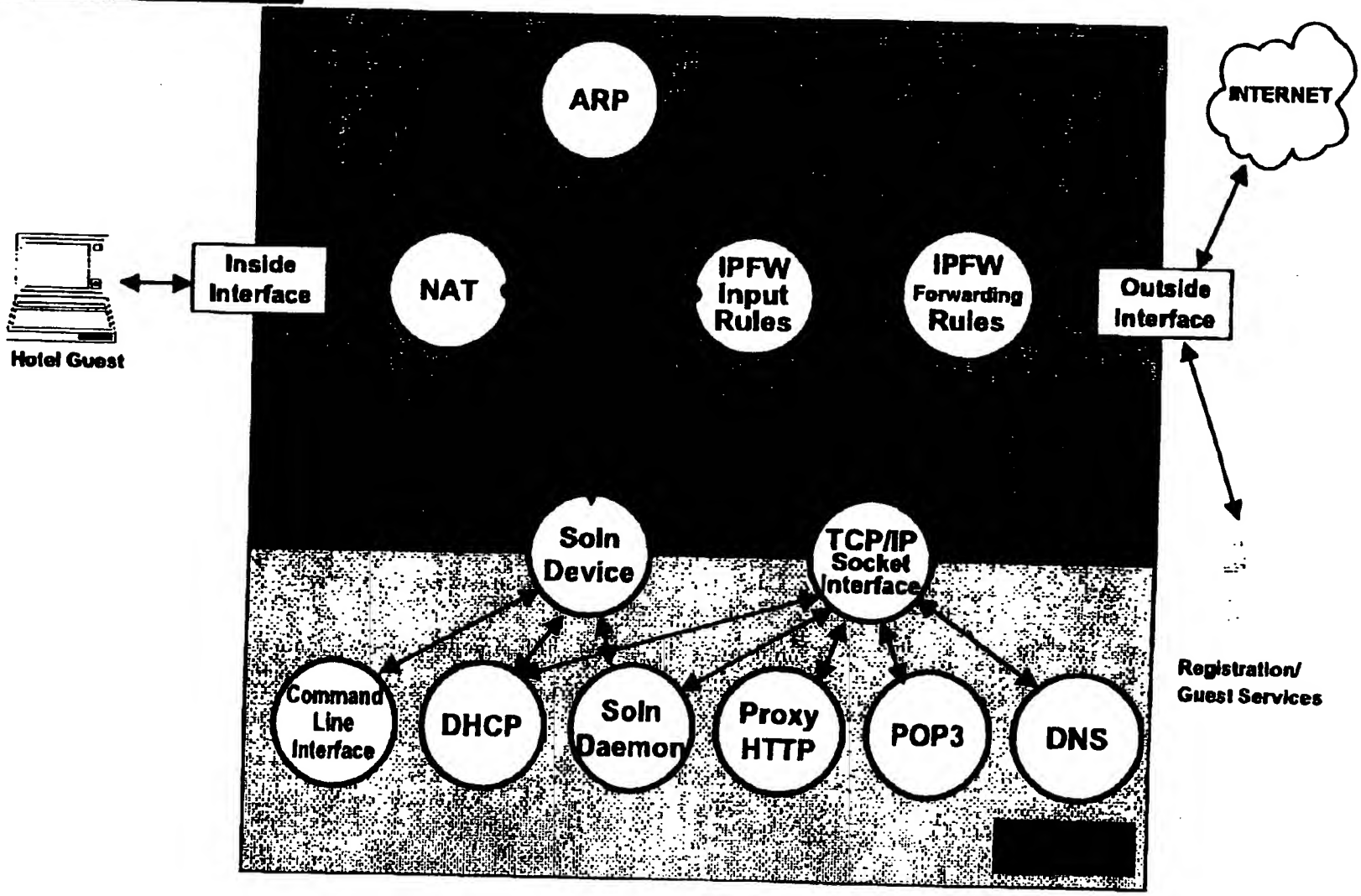
SolutionInc

SolutionSERVER Registered HTTP Request



SolutionInc

SolutionSERVER Overview



SOLUTIONIP
FUNCTIONAL SPECIFICATION

DRAFT

27 January 1999

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Software Kinetics Document No. H1260-03-004

TABLE OF CONTENTS

LIST OF FIGURES

1 INTRODUCTION

SolutionInc Limited defined a suite of products based on an intelligent building Internet communications infrastructure, SolutionIBS. Based on the SolutionIBS model, a number of building specific implementations (products) were defined. All implementations share a set of features and functions aimed at simplifying Internet connectivity for people living or working within a SolutionIBS building. SolutionInc asked Software Kinetics to develop the "Plug-and-Go" connectivity component essential to SolutionIBS. The "Plug-and-Go" connectivity, known as SolutionIP, allows tenants (or guests) in a building to re-locate and re-connect to the Internet from any location within the building in such a way that the Internet access appears transparent and seamless.

The initial implementation of SolutionIP is for the hotel industry. The primary objective is to provide guests with the ability to log into the Internet from their hotel rooms without having to modify their personal computer network settings. The guests will be able to transparently and seamlessly get their email, surf the web, etc. as if they were in their offices.

This document details the functional specifications of SolutionIP as developed by Software Kinetics.

2 USAGE SCENARIO

A typical usage scenario for the SolutionIP product consists of a business traveler requiring access to the company email server from their hotel room. After connecting their laptop to the hotel room's network jack and registering for the SolutionIP service, the hotel guest can access the Internet, as well as online hotel services (Virtual Concierge) using the hotel's high-speed Internet connection. They can then connect to the company email server via the Internet as if they were on the company Local Area Network (LAN), and at speeds much higher than possible using a dial-up network connection (See Figure 2-1).

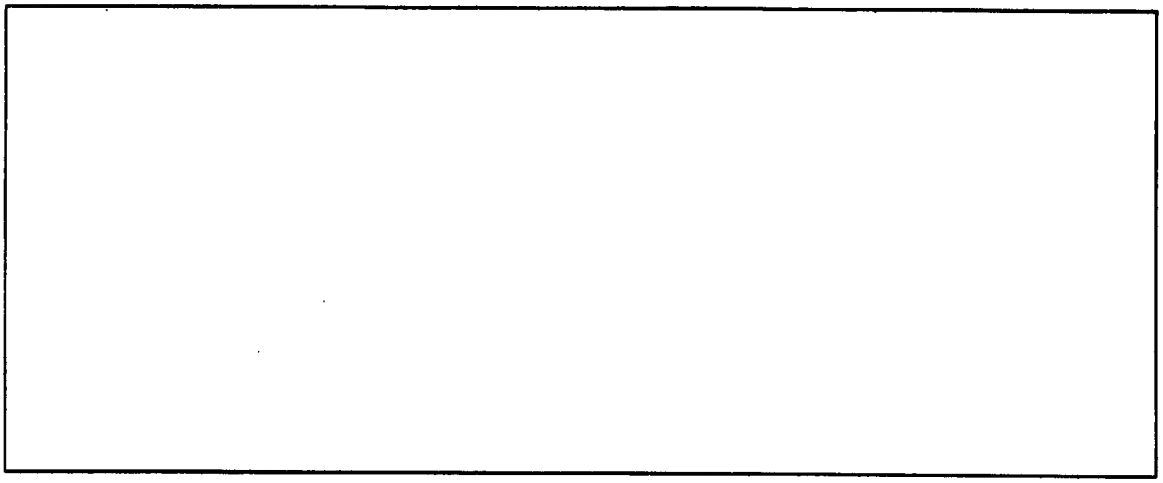

Figure 2- Usage Scenario

SolutionIP is a server-based solution designed to allow users to connect a computer with a working Ethernet network interface card (NIC) and an IP-based network configuration to the Internet. The guest would physically connect to the SolutionIP system via a network interface connection. Most users will have seamless connectivity, however there are limitations, which are described in detail in Section 3.4 Client Requirements.

Users are required to register with the system using a browser application before Internet connectivity is established. The server will detect all attempts at gaining access to the Internet and continue to redirect users to an SolutionIP web site until registration is completed. Once registered, they will be able to use the high-speed Internet connection of the hotel to access corporate computing resources and email via the Internet, browse the World Wide Web (WWW), etc.

Guests attempting to pop their email prior to registration will be issued an email message. The message simply asks them to register using their browser before email can be downloaded.

3.1 Functional Decomposition

SolutionIP translates network traffic from client (hotel guest) computers in such a way that it can be properly routed to and from the client via the hotel Internet connection. This is possible regardless of the current network settings (IP address, DNS servers, gateway, etc.) on the client machine, provided that the existing configuration is functional. (i.e. The client machine must have a working network configuration, although the actual addresses used are not expected to be configured for the hotel's network). SolutionIP will transparently translate the settings of the client machine into addresses appropriate to the hotel's network environment while routing data to the Internet. In addition, the server will then "reverse translate" return network traffic to use addresses compatible with the client computer's configuration.

More specifically, only IP-based protocols are currently supported. Other types of network traffic are ignored and not forwarded by SolutionIP. SolutionIP will provide DHCP (Dynamic Host Configuration Protocol) server functionality, which will be used to supply configuration data to those clients configured to dynamically obtain their network settings. DNS (Domain Name Service) requests are to be intercepted by SolutionIP (based on destination port number) and serviced locally by a DNS server running in the hotel. Outbound network traffic is intercepted by the SolutionIP server, which acts as a gateway to the Internet and forwards the data as appropriate. SolutionIP will pretend it is the client's gateway, even if the client has specified a different gateway, such as the one

normally used by the client in the office.

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Unauthorized use of the network (i.e. network traffic from clients who have not registered for the network service) will be blocked by SolutionIP until the client registers. SolutionIP will maintain a list of those client computers which have been registered and are authorized to use the network. Traffic from authorized clients is routed, while other traffic is discarded or redirected. Please refer to Section 3.3 Registration and Usage Component for further details.

SolutionIP will not prevent facilities such as VPN (Virtual Private Network) connections and VLAN (Virtual Local Area Network) capabilities, however they are not currently directly supported.

Figure 3-1 provides a functional decomposition showing the major system components and their interactions:

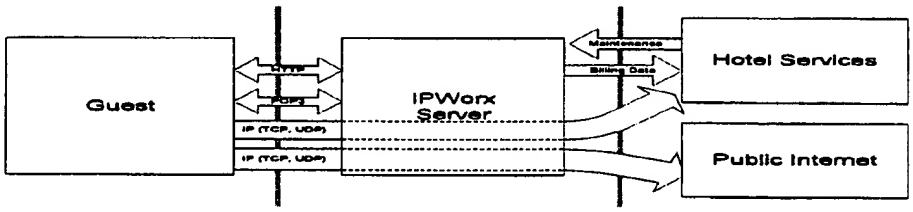

Figure 3-1 Functional Decomposition

A guest can communicate with the SolutionIP server via Hypertext Transfer Protocol (HTTP) requests (the protocol used to access the WWW), or email requests (POP3 protocol only). Once registered, IP-based traffic originating from the guest's computer passes through the SolutionIP server to the Hotel Services Intranet or to the Public Internet.

3.2 Security Considerations

In general, the SolutionIP solution is not directly involved with attempts to secure the hotel network from external threats. Creating and enforcing a security policy for the Internet connection of the hotel is to be dealt with by other components of the overall solution. SolutionIP does not perform filtering of in-bound network traffic destined for registered clients.

The SolutionIP server has all unnecessary services disabled and file permissions checked to try to prevent malicious modifications. The only login access to an SolutionIP server is by secure shell (SSH) or from the console.

3.3 Registration and Usage Component

The registration component is a web-based application, which allows hotel guests to register for the network service, as well as log off from it. It is accessible to all guests who are connected to the network (i.e. access to the registration site is not blocked by SolutionIP). The web server for the registration component runs on a separate machine from SolutionIP minimizing the load on SolutionIP.

Prior to registration for the network service, any attempts to access WWW and POP3 (a type of email) servers are detected by SolutionIP and intercepted. This is based on the TCP port number. These requests are answered by SolutionIP or forwarded to the web server where information is provided on how to register for the hotel network service. Future expansion of the product could include interception of other types of application protocols (other email protocols, for example).

SolutionIP also has the ability to track registration information, which can be used for billing purposes. Currently this information is available through an administration web site that displays who is connected to the network, who is registered, time and date of registration, etc. The server does not currently track data volumes, but such a feature can be implemented in the future.

3.4 Client Requirements

Although the system is a server-only solution and transparent to registered clients, there are certain minimum requirements for client computers. SolutionIP is designed to operate without modifications to the client's computer configuration in the majority of cases, but certain components must be present and working. There are some situations in which manual configuration changes (e.g. disabling proxies) will be necessary. A possible future client-side utility might be required to enable certain systems to access the network.

Minimum client requirements:

•Ethernet Network Interface Card installed and configured, with compatible interface to hotel network jacks;
•Installed TCP/IP stack, configured for DHCP or for static IP address, gateway, and DNS server(s); and
•Web browser configured for direct network access (i.e. not a dialup-only browser configuration and without proxies enabled). (Only required for registration/log-off process and possible client usage).
It must be noted that there are limitations inherent in any non-client solution. Many of these can be overcome by manual reconfiguration. It is important to specify that this solution will be subject to the limitations described in the "IPORT™ - Version 2.0 Technical White Paper" (Pages 7 and 8 of 11) for server only solutions. The limitations described in this white paper are discussed in the remainder of this section.

Below are the areas of capability where a client component is advantageous to a server only solution.

•"Connects users who have configuration settings that prevent connection to server-only systems (about 30% to 40% of users)." If the user has satisfied the minimum requirements described above, then they likely already have a way of connecting directly. In the rare instance that they are configured to access the Internet through dial-up only then manual reconfiguration would be required.
•"Diagnoses configuration problems that prevent connection (about 10% of users)." A configured Ethernet card is a client requirement. In cases where the traveler does not normally have a Ethernet card installed (such as where they use a docking station with a built in card), the user would have to install and configure an Ethernet card before using the SolutionIP system.
•"Performs quickly over high-speed connections, including fiber and DSL." Although this may become a problem, there are options for dealing with this when it does become an issue, such as using multiple servers and load balancing. This is an area that would require work beyond the

scope of this project.
•"Supports DCOM standard for distributed Internet computing." If the client is using DHCP then this standard would be supported. If they are not, some re-configuration would be required.
•"Supports dial-up configurations." Not supported by SolutionIP.
•"Supports IPSec, L2TP and other Internet security protocols." If the client is using DHCP then SolutionIP would support this. Otherwise, manual re-configuration would be required.
•"Supports Mobile IP standard for automatic, secure routing of information from mobile computer users' home offices to their laptops." If the client is using DHCP then SolutionIP would support this. Otherwise, manual re-configuration would be required.
•"Supports VPN standard for encrypted communication to corporate computers over the Internet." If the client is using DHCP then SolutionIP would support this. Otherwise, manual re-configuration would be required.

3.5 Future Additional Functionality

The requirements described in this document are sufficient to allow the majority of clients to connect easily to the Internet via hotel networking facilities. However, some clients will have system configurations that will not allow connectivity through the SolutionIP server. There are a number of possible additions to the basic system described in this document which could be considered for future releases. These additions are described below:

•Support for additional application protocols, including other email protocols such as IMAP4 to provide notice to guests that they must register for the network service. (e.g. provide information to users of protocols other than POP3 and the WWW, explaining that they must register before being able to use the network and how to do so).
•A client-side utility to assist with configuring those systems which cannot be accommodated using a server-only solution. Such a utility could take the form of a simple diagnostic tool which would provide information as to why the client is unable to connect properly, providing information for manual reconfiguration, or a fully featured application. The fully featured application would actually reconfigure the system for the user and then undo the modifications following log-off.
•The specifications call for only IP-based protocols to be supported by the SolutionIP server. Depending on demand and technical feasibility, it may be desirable to add support for other network protocols as well.
•Increased support for Virtual Private Networks (VPNs) and Virtual Local Area Networks (VLANs).

•Support for SOCKS clients by intercepting SOCKS traffic based on TCP port number and redirecting such traffic to a local SOCKS proxy server. This sort of approach would be similar to that used for servicing DNS requests, and may allow clients whose systems are configured to use proxies to successfully connect to the network without requiring manual reconfiguration or a client-side utility.
•The impact of emerging standards for enhanced security in IP networking and for mobile computing such as IPSec, L2TP, and Mobile IP should be examined. Modifications or additions to the initial solution may be required, as these protocols become more popular.

4 HIGH LEVEL DESIGN

SolutionIP can provide transparent network access via two mechanisms:

•Network Address Translation (NAT): Each internal system is given a unique IP address to communicate with the Internet. This allows external connections to clients and facilitates UDP based protocols as well, but will require that a sufficient set of routable IP numbers be available for assignment at each installation.

•Masquerading: Each internal system appears to the outside world with the IP address of the server. This would require the development of special protocol-aware handlers (proxies) for protocols like active-mode FTP which try to create independent return connections back to the client, and modifications would be necessary to support UDP "connections" (statefull packet inspection).

SolutionIP will utilize NAT as the primary mechanism for providing transparent network access. Despite the problems associated with IP number allocation this choice offers the best available mechanism to effectively deal with various unsupported network protocols. SolutionIP will be based on a customized version of the Linux operating system.

There are two main scenarios:

•The client is configured to use a particular, fixed IP configuration: the server captures Address Resolution Protocol (ARP) requests from the client and the server responds with its own MAC address. The client is assigned an IP address, which is mapped to the client's configured IP address and its MAC address. If the client has not "registered" for the service, then the first attempt to communicate with a web server or a pop server will result in a redirection to the registration screen (web) or a mail message with directions to the registration screen. From this point until the client logs off the system, their traffic is allowed to proceed unimpeded. As the traffic passes through the server, the IP address of the client is translated back and forth between the configured (fixed) IP address and the server-assigned IP address.

•The client uses DHCP. In this case SolutionIP's DHCP server component assigns an IP address and then SolutionIP acts simply as a router, except that normal IP traffic is blocked or redirected until the client goes through the registration process.

4.1 Core SolutionIP Components and Interactions

Figure 4-1 shows the breakdown of the core components of the SolutionIP product and their interactions. These components are further described on page 4-3.

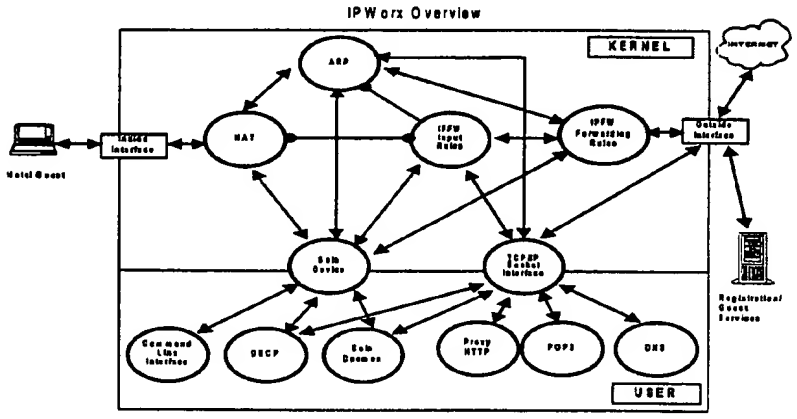

Figure 4-1 Core SolutionIP Components and Interactions

Components: The following are the major system components which have been identified:

ARP – The Linux ARP service will be modified. Normally, a system only responds to an ARP request if the ARP request contains the system's IP address. Instead of only responding to ARP requests for its own IP address, the modified ARP service will respond to any ARP request with its MAC address, regardless of the IP address specified. This will allow SolutionIP to pretend to be the gateway, DNS server, etc. for clients using fixed IP configurations. The changes must be made in such a way that the modified ARP service can be enabled or disabled on a per-network-interface basis.

Registration Device Driver (Soln Device) – A pseudo device driver needs to be written to manage the registration data. It will keep track of client IP/MAC to assigned IP mappings, registration status, and various time-related parameters (how long the registration is valid for, for example). The information will be stored in kernel memory for read-only access by other portions of the kernel such as ARP and the Ethernet Packet Drivers. This driver will also be responsible for maintaining the pool of addresses available for assignment (for both NAT and DHCP).

Command Line Interface / Soln Daemon – A command level control program to allow examination and re-configuration of the components of the server must be implemented. Primarily this will be for monitoring the Registration Device Driver and checkpointing the registration to disk for recovery purposes. It will support both an interactive command-line mode, as well as a daemon mode. It will normally run in the daemon mode. This daemon will accept notification that a user has registered or de-registered and update the device driver to allow/disallow network traffic for that client as appropriate.

IPFW – The standard Linux packet filter IPFW (IP Firewall and Accounting) will be modified to perform filtering and redirection (of web and pop traffic initially) based on the stated information maintained by the Registration Device Driver.

Ethernet/IP Packet Drivers – These must be modified to interface with Registration Device Driver to determine a guest's registration status, as well as to look up and apply any address translation to the packet headers. Both IP and MAC address information must be utilized in the lookup and translation, in case multiple guests are using the same IP address.

DHCP Server – A DHCP server must be installed on the SolutionIP machine. The code for this

DHCP server must be modified so that it obtains new IP addresses to assign from the Registration Device Driver, rather than from its own pool of addresses to manage.

POP Server - A pop server will be modified to provide any mail download request with one new mail message that would instruct the user to register using their web browser. Normally packets would only arrive at this server via redirection by the packet filter.

WEB Server - A web server will be modified to redirect any requests to the registration system. Normally packets would only arrive at this server via redirection by the packet filter.

Registration WEB Server - The web server and web pages that actually handle the registration dialog and communicate the registration state to the registration daemon.

DNS Server - A Domain Name Service (DNS) server must be installed and configured on SolutionIP to provide local name resolution services to guests. This will serve as the primary DNS server for clients using DHCP. It will also service DNS requests from clients using fixed IP configurations which have been redirected to the DNS server by the packet drivers.

4.2 DHCP Request Processing

Figure 4-2 describes the processing performed by SolutionIP for DHCP requests:

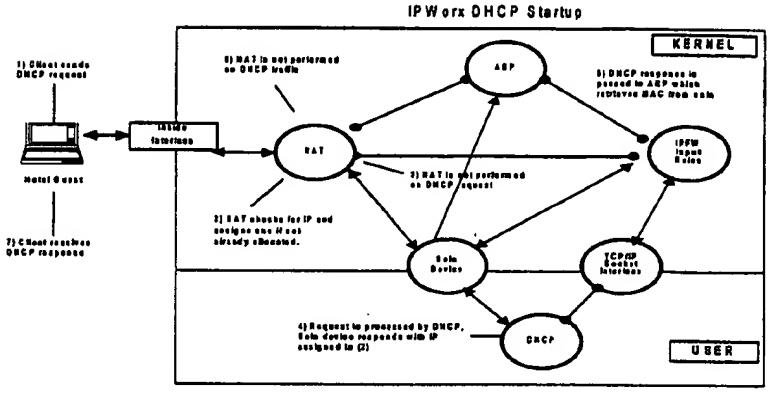

Figure 4-2 DHCP Request Processing

When a guest with a computer configured for DHCP powers on, the computer initiates a DHCP request to the other computers on the LAN. The modified DHCP server will receive and process that request. The DHCP server will capture the MAC address of the guest computer and initiate a request for an IP address to the Registration Device Driver. The Registration Device Driver provides an appropriate IP address for the guest. The IP address is returned to the DHCP server, which then passes the address and any additional parameters (gateway to use, DNS server to use, etc.) back to the guest's computer.

4.3 ARP Request Processing

The processing performed for an ARP request is described in Figure 4-3, below:

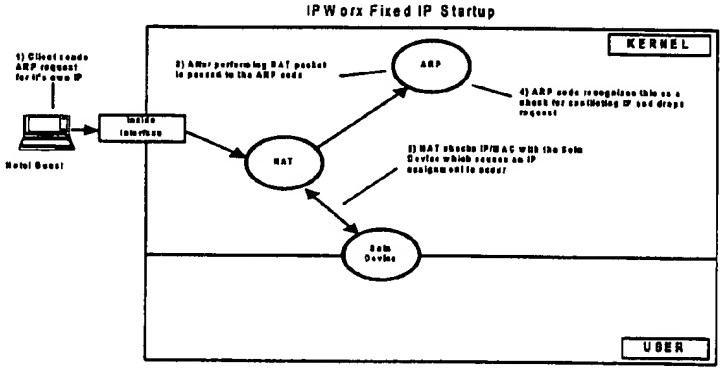

Figure 4-3 ARP Request Processing

To identify exactly which machine on a LAN has a particular IP address, a guest's computer will initiate an ARP request, asking for the MAC address of the machine having the specified IP address. SolutionIP will detect the ARP request and respond with its own MAC address via the modified ARP server, regardless of the IP address actually requested. While processing the ARP request, the ARP server will notify the Registration Device Driver of the guest computer's MAC address and IP address. The Registration Device Driver can then determine if a matching MAC address and IP address pair exists, as well as whether NAT will be required for the guest computer. The Registration Device Driver will then update its data structures with the new information if necessary.

4.4 Unregistered HTTP Request Processing

Processing of HTTP requests involves redirecting unregistered guests to the registration web server, and allowing requests from registered guests to be routed normally. Processing of unregistered HTTP requests is shown in Figure 4-4, while processing of registered HTTP requests is shown in Figure 4-5 as an example of general IP based processing.

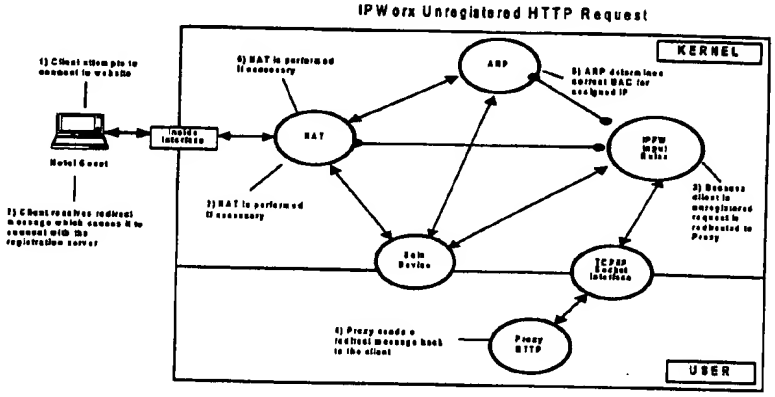

Figure 4-4 Unregistered HTTP Request Processing

Processing of a Hypertext Transfer Protocol (HTTP) request begins with receipt of the request by SolutionIP's packet drivers. These drivers query the Registration Device Driver to identify whether NAT translation of the packet headers is required. If required, the packet drivers perform this translation. The IPFW component is then given control of the request. It queries the Registration Device Driver to determine whether the guest is registered. If the guest is registered, it allows the request to be routed normally. If the guest is not registered, the request is passed to the modified Web Server, which translates it into a request for the registration area of the Registration Web Server. The translated request is then submitted to the Registration Web Server and the guest is presented with the hotel's registration screen. If the guest chooses to register for the network access service, this information is provided to the Control Program/Daemon, which updates the Registration Device Driver appropriately. Subsequent requests from the guest computer following the update of

the Registration Device Driver will be processed as from a registered guest.

4.5 Registered HTTP Request Processing

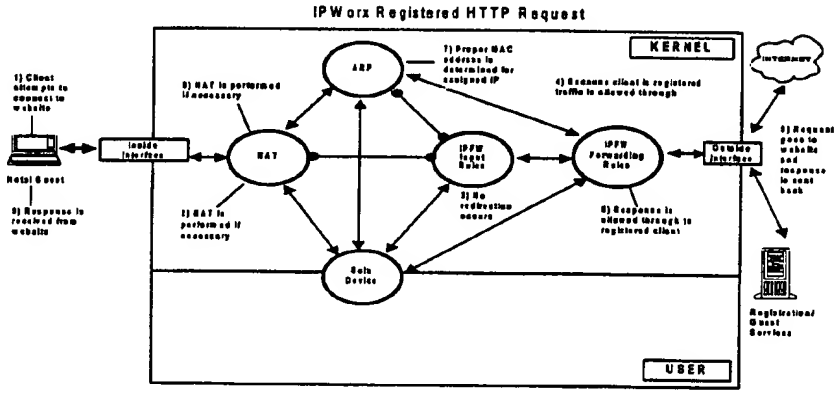

Figure 4-5 Registered HTTP Request Processing

The general processing performed by the SolutionIP server for IP-based traffic other than web and email traffic is the same as shown in Figures 4-4 and 4-5, except that it is not subject to redirection. IP-based traffic initiates from the guest's computer and is sent to the SolutionIP server. The packet drivers on the SolutionIP server then determine whether the traffic requires NAT and performs translation on the headers if so required. The IPFW packet filter then determines whether the guest has registered for the network access service. If the guest is registered, the data traffic is allowed to proceed and is routed normally. If the guest has not registered, the data is blocked by discarding the incoming network packets.

DRAFT

FUNCTIONAL SPECIFICATION FOR THE SOLUTIONIP BASIC BILLING SYSTEM

23 April 1999

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1. INTRODUCTION

This document describes the specific functional requirements for the initial release of the SolutionIP Billing System. It is expected that future development efforts will expand the functionality and administrative support options of the system. The current emphasis is on rapid design and implementation of a solid, minimal system that will not interfere with the future implementation of advanced functionality.

This release will support two methods of registration, access codes and port identification. Access codes will be generated for each room on a daily basis. Clients must enter the access code for their room as part of the registration process. Port identification will automatically determine the client's room number by querying the network switch infrastructure to determine the specific switch port from which the client is connected. Switch ports will be mapped to specific rooms. Access codes can be used in the event the client is not connecting from a guestroom, such as when working from a public area in the hotel, or if the switch port cannot be determined.

Authorization codes will be supported as an override mechanism to apply special processing rules (discounts, free usage, etc.) to particular clients. This release of the system will store and display the authorization code as part of the billing report. The interpretation and application of authorization codes will be the responsibility of hotel staff.

The hotel Property Management System (PMS) will perform the actual billing of clients. The billing system will provide web-based reports which can be printed and manually entered in the PMS by hotel staff.

This document will describe in detail the core functionality of the billing system. The specific components comprising the system will be identified and described in detail. The requirements for the billing database will be presented, as well as a description of the billing system interface and reports.

2. REFERENCES

The following documents contain information relevant to this functional specification.

- H1260-001 - Draft Functional Specification for SolutionInc Ltd. - 10 June 1998;
- H1260-001 - SolutionIP Technical Support Manual Draft - 8 April 1999; and
- RFC 1493 – SNMP Bridge MIB.

3. REQUIREMENTS

SolutionIP requires two Pentium class systems operating at 200 MHz or greater. One functions as the SolutionIP server while the other hosts the web site and database. These machines require the following hardware:

- 64MB RAM;
- 4.5GB hard drive;
- Network Interface Card (NIC) (Linux compatible) NOTE: The SolutionIP server requires two NICs and the web server requires one;
- Monitor and keyboard are optional; and
- Two serial ports.

The client component has the following requirements:

- Network Interface Card and connector;
- Web browser;
- TCP/IP stack; and
- A printer connection will be required for billing reports.

SolutionIP must support a variety of client operating systems including Win95, Win98, WinNT, MacIntosh OS 8 and Linux.

The switches for port identification must support:

- Bridge MIP (RFC 1493);
- SNMP read access; and
- 1-1 mapping (room to port).

The software requirements are based on the functionality of each machine:

- SolutionIP Server:
- Operating System - RedHat Linux 5.1.
- SolutionIP Web/Database Server:
- Operating System - RedHat Linux 5.1;
- Web Server – Apache;
- Database - PostgreSQL 6.4 or higher; and

•Perl 5.004.

4. AREAS OF FUNCTIONALITY

Three main areas of functionality exist for the billing system. These include port identification, access code generation and interpretation, and billing system administration. This section will present an overview of the general requirements of the system, as well as the specific requirements for each of the areas of functionality.

a. Overview of Billing Requirements

Billing will begin with the identification of the room associated with each client. Rooms will be identified either manually by associating an access code with a particular room, or automatically by obtaining the switch port the client is connected to and deriving the associated room. The system will provide facilities to automatically generate a new access code for each room, either for the current day or the next day. The codes will be displayed via a web page and can be printed. A configurable history of access codes will be maintained to prevent duplicate codes from being generated within the history period. No mechanism will be provided to prevent access codes from being used more than once or by more than one client. Each new MAC registering will be billed to the associated room. Registrations will be valid until the next checkout time. The access code will be used to determine which room to bill, and so it will be the responsibility of the client to ensure that the code is kept secure. Billing will be based on the room from which the client registers when using port identification.

Once the room is identified, the fee associated with that room will be determined. A flat fee per day will be associated with each room (different rates can be charged for different rooms). The registration interface will allow clients to enter special authorization codes. These codes will be stored with the client's billing information. Authorization codes used will be included in the billing report generated for hotel staff, but will not actually affect the fee generated by the billing system. Interpretation and application of authorization codes will be the responsibility of the hotel staff.

A web-based billing report will be provided and printed by the hotel staff. It will display who has been online since the last checkout time. Additional queries for arbitrary dates will also be available. These will show who was online from checkout time on the specified day until checkout time the next day. Information included in the report will include client room, registration time, access code, port, authorization code, and fee. Access to all administrative web reports will be password protected.

The database must be capable of storing one month worth of data. Backup, restoration, and disaster recovery procedures are not required.

b.Port Identification

One method of associating a client (MAC Address) with a Room for billing purposes will be Port Identification. If, on registration, the physical port connection can be identified as being associated with a room, then that client's registration will be billed to that room. To determine what physical port a client is connected to the Simple Network Management Protocol (SNMP) will be used to discover which switch port they are talking to, static data tables are then used to determine the room number.

•The switch/port number that a MAC is using will be determined by using SNMP to search the installation's switches.

• Mapping from the switch/port number that a MAC appears on will identify physical ports. This mapping will be maintained in the database.

•Physical ports will map to room numbers and billing rates. These mappings will be maintained in the database.

•The determination of the MAC to physical port mapping will be done on an as required basis.

•If port identification is available it will take precedence over access code identification and no access code will be requested of the user during the registration process. The exception to this would be physical ports flagged as requiring a valid access code for registration to succeed.

c. Access Code Identification

An alternative to Port Identification is Access Code Identification. Each access code will be associated with a particular room and will be valid for a limited time period (usually one day from checkout time to checkout time). If port identification fails or is not available on a given port then the client will be prompted for an access code which the system then validates. This will ensure that a billing record is generated for the appropriate room.

Access codes must be:

•generated daily;
•6 characters long;
•comprised of capital letters and digits determined randomly with the following omissions: '1' (one), 'I', 'L', 'O' (oh), '0' (zero), '2' (two), 'Z', 'U', 'V';
•unique for some historical period (30 days by default);

•associated with a specific room number and billing rate;
•used if port identification cannot be made for a MAC requesting registration, or if the physical port is flagged as requiring an access code; and
•entered in either case, but will be converted to uppercase during processing.

d. Administrative Features

This section of the document will describe the administrative features incorporated into this release of the billing system. The administrative features will serve as the interface between the billing system and the hotel staff. The two features included in this release are the billing and access code reports.

i. Billing Report

The billing report will provide information to the hotel staff regarding room numbers, access codes, authorization codes, physical ports, registration time and fees. The report will be web-based and viewable from a standard web browser. The hotel staff will be able to generate and view the report on an as-needed basis.

The following are mandatory requirements for the billing report, the report must:

•produce a web-based billing report in a printable form;
•include all charges to be applied to each room (not including special promotions or discounts);
•be displayed in an organized, clear, and easy to read format, sorted by room number;
•include the ability to view reports for dates other than the current billing period;
•only be accessible to hotel staff responsible for billing;
•include the room number, access code, authorization code, physical port, registration date and time, MAC address, and fee for each connection;
•report charges from checkout time of the specified day until checkout time the next day; and
•reports for the current day will show charges from the last checkout time until the current time.

ii. Access Code Generation and Report

The access code report will provide hotel staff with the information related to room numbers and access codes. The report will be web-based and viewable from a standard web browser. The hotel staff will be able to generate and view the report on an as-needed basis. Upon reviewing a report, the system will automatically generate access codes for the current or the following day if they do not exist in the database.

The access code report must:

•produce a web-based access code report in a printable form;
•be displayed in an organized, clear, and easy to read format, sorted by room number;
•only be accessible by the hotel staff responsible for handling the access codes;
•include the ability to view access codes for dates other than the current date;
•include each room number and its associated access code; and
•automatically initiate generation of new access codes for the current or next day if they do not exist when the report is requested.

5. FUNCTIONAL COMPONENTS

a. Overview

The billing system will consist of components running on both the SolutionIP Server and the Web Server. The Web Server will host the billing and configuration database, the Admin Interface which will be part of the Admin web site and the Registration Interface which will be the existing Registration Web pages with modifications to accommodate the new billing system methods. On the SolutionIP Server the Registration Driver and Command Line Daemon will be modified to accommodate the new billing system methods. Two new daemons, the Synchronization Daemon and the SNMP Daemon, will be implemented to support the billing system and future functionality.

Figure 5-1 displays a flow diagram of the interaction between the two servers and the suites and clients.

Figure 5-1 Flow Diagram

b. Database

The SolutionIP Billing System will be implemented using a PostgreSQL 6.4 database. The database will store configuration information, access codes, and billing records. One month of data will be maintained at any given time. Data older than one month will be regularly purged from the database. Database backup and recovery procedures are not required.

Configuration data handled by the database will include switch configuration information (switch addresses, types, mappings of switch ports to rooms, etc.). Hotel checkout time, amount of data history to maintain, and other related parameters will also be stored in the database.

The database will store the access code and its effective dates for each room. By default, each code will only be effective for one day. A history of access codes for each room will be kept. New codes will be checked against this history to prevent duplication.

Billing records will identify the room to be billed for each connection. The following fields will be included in this record:

- room number;
- port registered from;
- access code used;
- authorization code;
- registration date and time; and
- type of fee to be charged.

In certain cases, some fields may be NULL. For example, the access code would normally be NULL when port identification is being used.

c. Command Line Daemon

This section of the document will describe the modifications and additions to the command line daemon for this release of the billing system. The daemon requires the ability to handle multiple simultaneous requests from other systems, preserve parameter changes and track the state of registration driver backups. The daemon also requires modifications to reflect the changes to the Registration Driver and to accommodate the addition of the SNMP and Synchronization daemon.

i. General

The Command Line Daemon must support:

1.multiple (simultaneous) requests;
2.persistent configuration parameters; and
3.automatic restoration of the last valid driver backup.

ii. New Registration Driver Interface Functions

The Command Line Daemon is the primary interface into the registration driver. Therefore, modifications and additions to the driver will affect the daemon. The functionality of the registration driver will change to accommodate the billing system. The Command Line Daemon will provide interfaces to all new functionality created in the registration driver. Additionally, existing interface functionality will change to allow operations based upon physical port and room number.

The Command Line Daemon will be modified to support the following new operations:

•set the original room and port id for a specified user;
•set the current room and port id for a specified user;
•block a specified user, so they can not register;
•unblock a specified user, so they can register;
•flag a specified entry as permanent;
•flag a specified entry as no longer permanent; and
•set a grace period (time period prior to checkout, during which registrations will not expire until checkout time the next day).

iii. Interface to SNMP Daemon

The billing system will communicate with the SNMP Daemon via the Command Line Daemon. The Command Line Daemon will channel all traffic between the other billing system components and the SNMP Daemon. The Command Line Daemon will also update the Registration Driver, where applicable, with the results received from the SNMP Daemon.

The Command Line Daemon will:

•respond to requests for port id resolution from both the registration server and kernel drivers;

- forward requests for port id resolution to the SNMP Daemon;
- receive port ids back from the SNMP Daemon;
- pass port id information back to requestor; and
- inform the kernel of port id information if the kernel was not the requestor of the transaction.

d.SNMP Daemon

The purpose of the SNMP Daemon will be to resolve MAC addresses to their physical port number, or return an error if this is not possible. This Daemon will use SNMP to interrogate the network switches to find the switch port that the client is connected to and then use static data tables to map that switch port to a physical port number.

•Configuration data will be obtained from flat data files stored on the SolutionIP Server;
•Configuration data files will be derived from database tables and updated by the Synchronization Daemon;

•When Configuration files are changed the SNMP Daemon will be informed by the Synchronization Daemon; and

•Requests and responses will be handled through standard Interprocess Communication Methods to other components on the system.

e. Registration Driver

The Registration Driver will require some modifications to support billing and production requirements. These changes are outlined in this section. The current driver maintains information on client MAC addresses, original IP addresses, and assigned IP addresses. Timing parameters are included to allow fixed-length registration periods, as well as inactivity timeouts for unregistered clients.

A Time of Day expiry mode will be added. The method of expiration will be determined at the time of client registration. Under the Time of Day expiry mode, registrations will expire at the next checkout time (or any arbitrary time each day). Currently new registrations are expired at the end of a fixed time interval, typically 24 hours. The Time of Day expiry mode is more consistent with normal hotel billing routines. The existing expiry calculation mode will be preserved as an option.

In addition to the new expiry mode, the ability to override parameters for individual clients will also be developed. Existing driver parameters server as defaults, and affect all clients. The new override mechanism will allow administrators to change specific parameters on a client-by-client basis. An example might be to extend the expiry time of a particular client, without affecting the expiry times of other clients.

In addition to operating on MAC and IP information, the driver will be modified to include room and port data. The work of associating rooms and ports with clients in the driver will be performed by external components (the billing system and SNMP daemon). Operations supported by the driver, such as registering or deleting entries, will be modified to allow such operations to be performed on all clients associated with a particular room or port.

Production requirements include the ability to reserve specific addresses or make entries permanent. This is important to support maintenance access to network devices, such as switches, which reside on the client side of the SolutionIP servers. A mechanism to block particular clients should also be implemented. This mechanism would identify clients by room, port, or MAC. Blocked clients would be able to access the registration server and other services available to unregistered guests, but they would be prevented from registering for full system access.

f. Synchronization Daemon

The purpose of the Synchronization Daemon will be to centralize access to the database by components of the SolutionIP Server through one interface. The daemon will use information stored in the database to create flat configuration files on the SolutionIP server. This allows configuration information for the various components to be centralized in the database but does not preclude their being maintained on the server if a database is not available or required at a particular installation.

When files are updated by the Synchronization Daemon, the processes that use them will be informed that an update is available (possible methods of communicating this include signals, IPC semaphores or having the process monitor the last modified time of its configuration files). Eventually it will become desirable to have this process update information in the database based on status files from the SolutionIP server.

6. INTERFACE

This section of the document will describe the interface for this release of the billing system. The user interface will be web-based and viewable from a standard web browser. Also documented is the interface between the web server and the registration system.

a. Administration

The administrative interface is available to users requiring access to the systems administrative features. The administrative interface components are described in the following sections: main administration, billing reports and access code reports.

i. Main Administration

The main admin web page serves as a home to the administrative functionality of the system. The page consists of the reports, administration and maintenance sections. Each section lists items of functionality appropriate to that section. The items are accessible using a standard hypertext link or via an imagemap. For this release of the billing system, there are two new report items: billing reports and access code reports. It is expected that there will be new report, administrative and maintenance items in future releases.

ii. Billing Report

The billing report interface allows users to view room, access code, authorization code, registration time, physical port and fee data, sorted by room, for a particular billing period. (See Figure 6-1).

•The billing report header will include the title and reporting period.

•The billing report will display the current day's information by default.

•The user can view reports for different dates using the navigation form located beneath the header. The navigation form includes two shortcut buttons for access to the previous or next day's billing data. It also includes a date entry field that allows users to view billing information for an arbitrary date. The date entry fields will contain default values equal to the last date processed (today's by default). A date is specified by entering a day in a two character input field, choosing a month from

a drop down selection box, and entering a year in a four character input field.

•The billing data for the specified date will be appear in tabular format. Columns will be clearly labeled and table data formatted to maximize readability.

•In order to ensure that the data is easy to print, no frames will be used.
•All of the report data will appear on a single HTML page.

•The report data table will show the following information, sorted by room number:
• room numbers;
•fees;
•registration dates and times;
•access codes;
•authentication codes;
•MAC addresses; and
•physical ports.

•If no billing data exists for the date specified, then an error message will be displayed.

iii. Access Code Generation and Report

The access code report interface allows users to view room and access code data, sorted by room, for a particular date. It also generates new access codes as required. (See Figure 6-2).

•The access code report header will include the title and reporting period.

•The access code report will display the current day's access codes by default.

•The user can view access codes for different dates by using the navigation form located beneath the header at the top of the report. The navigation form includes two shortcut buttons for access to the previous or next day's access codes. It also includes a date entry field that allows users to view billing information for an arbitrary date. The free form date area will contain default values equal to the last date processed (today's by default). A date is specified by entering a day in a two character input field, choosing a month from a drop down selection box, and entering a year in a four character input field.

•The access codes for the specified date will be appear in tabular format. Columns will be clearly labeled and table data formatted to maximize readability.

•In order to ensure that the data is easy to print, no frames will be used.

•All of the report data will appear on a single HTML page.

•The access code table will show:
• room numbers; and
•access codes.

•Access codes will be generated automatically for the current date or the following date if they do not exist when requested.

•If the specified date is not within the current history period, the current date, or the following date, an error message will be generated.

b. Web Server Registration Process

The existing registration process will be modified to take advantage of the new billing system methods. When a client attempts to register, the system will first attempt to determine if they are connecting from a room that allows billing via the port identification method. If a billable room is identified using this method then the user will be presented with the Authorization - Confirmation Screen. If a billable room cannot be identified using the Port Identification Method then the Access Code Identification method will be used. The user will be presented with an access code entry screen, when the user enters a valid access code then the billable room will have been identified and they will be presented with the Authorization - Confirmation Screen. The Authorization - Confirmation Screen will present the user with the room number and rate and any other important information. The user will also be given the opportunity to enter an optional Authorization Code. Once the user confirms their willingness to pay the specified rate they will then be taken to The Virtual Concierge.